# Measuring Half-Lives

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Basic nuclear science is an essential part of the high school science curriculum. Certain topics in nuclear science, like the concept of a half-life, are something that every physical science student should know. However, it is very difficult to perform nuclear science experiments in a high school laboratory setting, and therefore hard to back up the theory with actual experimental results. This project was designed to help address this problem by putting real nuclear science data onto the World Wide Web. By following the procedure now on our Web site, students can determine the half-lives of seven different isotopes. The idea is that by doing this, the concept of a half-life will seem less abstract and easier to comprehend.

In order to produce several isotopes' characteristic gamma spectra we needed to make these isotopes from their respective natural elements. We did this through neutron activation. In theory, every element can be neutron activated, but in practice, certain strict conditions must be met in order to get good data. We found six elements that fit the conditions: sodium, vanadium, manganese, iodine, lanthanum, and gold. With samples of these elements we measured gamma-ray data sets for the isotopes $^{24}$Na, $^{52}$V, $^{56}$Mn, $^{128}$I, $^{140}$La, and $^{198}$Au. We also produced a data set using a radioactive isotope generator: $^{137}$Cs/$^{137}$Ba$^{m}$

To measure the gamma rays emitted from each isotope, we used a coaxial germanium detector 5 cm thick and 5 cm in diameter sitting directly in front of the isotope sample. We acquired the gamma ray spectra in 4096 channels using an ORTEC, PC based data acquisition system. The spectra were accumulated in 9-26 time bins whose durations were chosen on the basis of the half-life of each isotope. Students can analyze these spectra on-line to determine the peak areas as a function of time. Instructions are provided that describe the steps needed to extract the half-lives of the isotopes. You can find all of the gamma ray spectra that we acquired for this project at http://ie.lbl.gov/gamma. We hope that this site will help students gain a better understanding of a number of basic concepts in nuclear science.

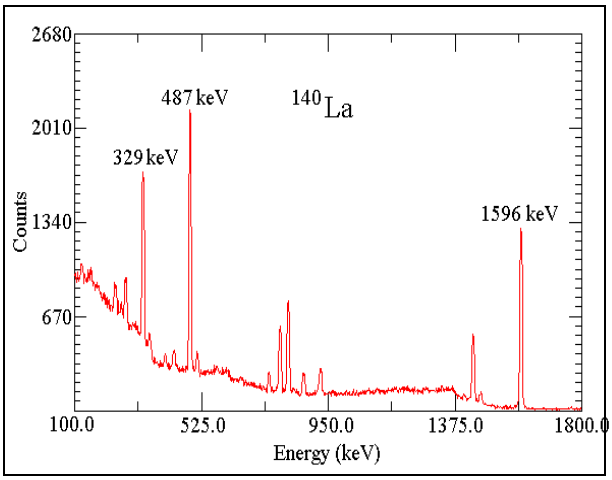


Fig. 1. A spectrum of $^{140}$La (Z = 57) displaying all three of its major gamma ray peaks.

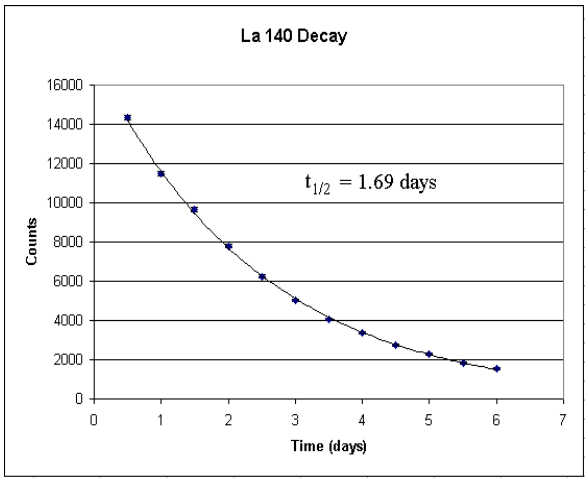


Fig. 2. The decay curve of the 1596 keV γ-ray from the decay of $^{140}$La. The half-life determined from this data is 1.70 days, which agrees well with the known 1.678 days.

*Footnotes and References*

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